Les of Airfoils in Turbulent Inflow

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LES of Airfoils in Turbulent Inflow

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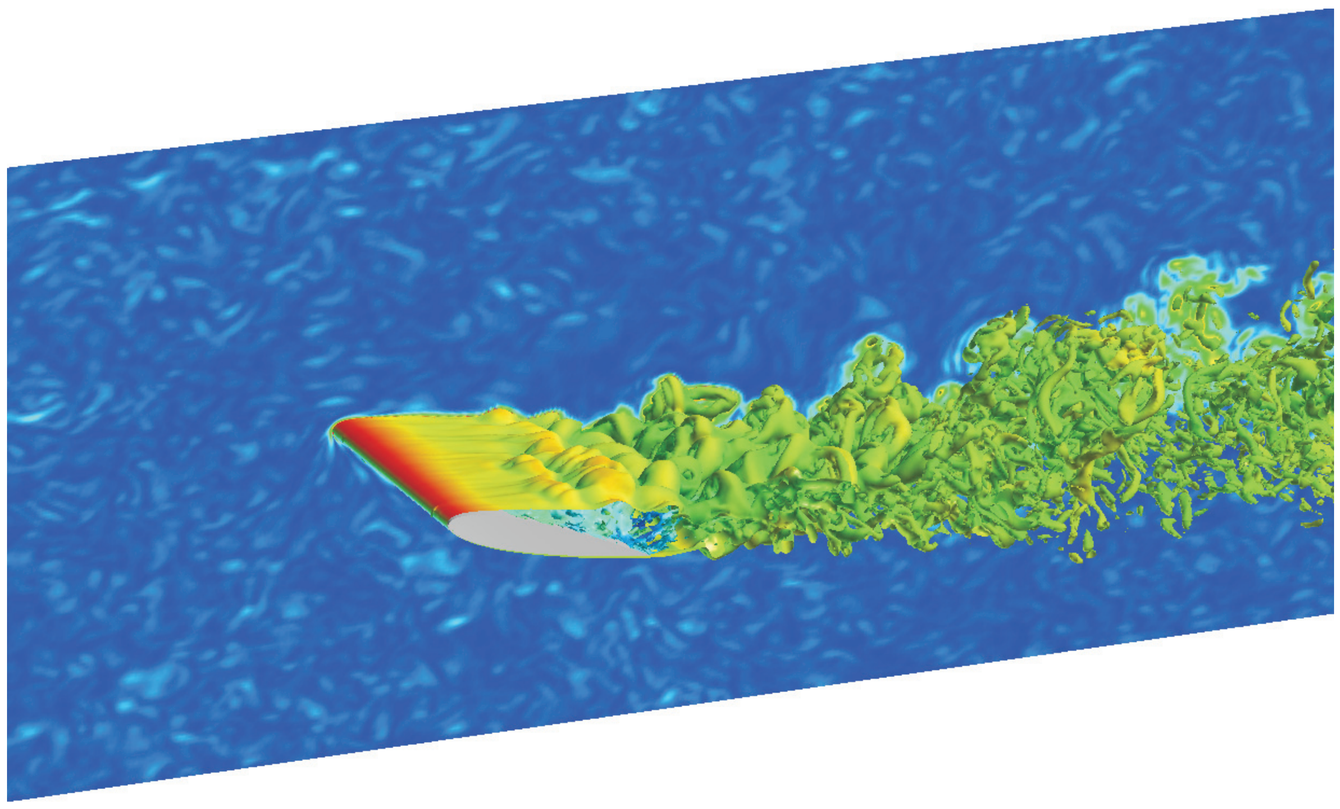
Purpose

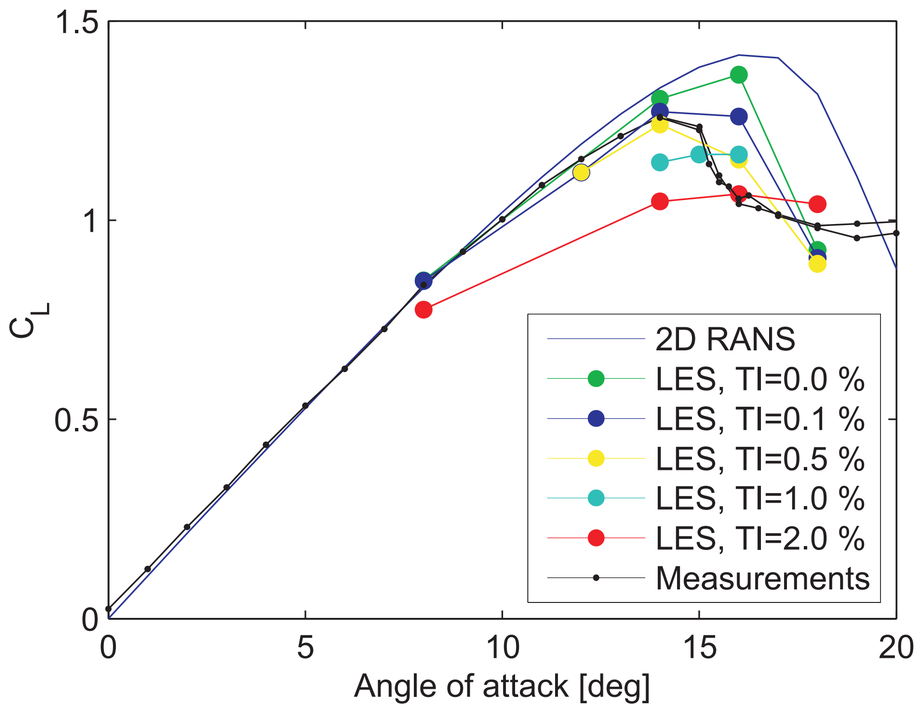
Study effect of resolving the inflow turbulence in simulations of airfoil flows

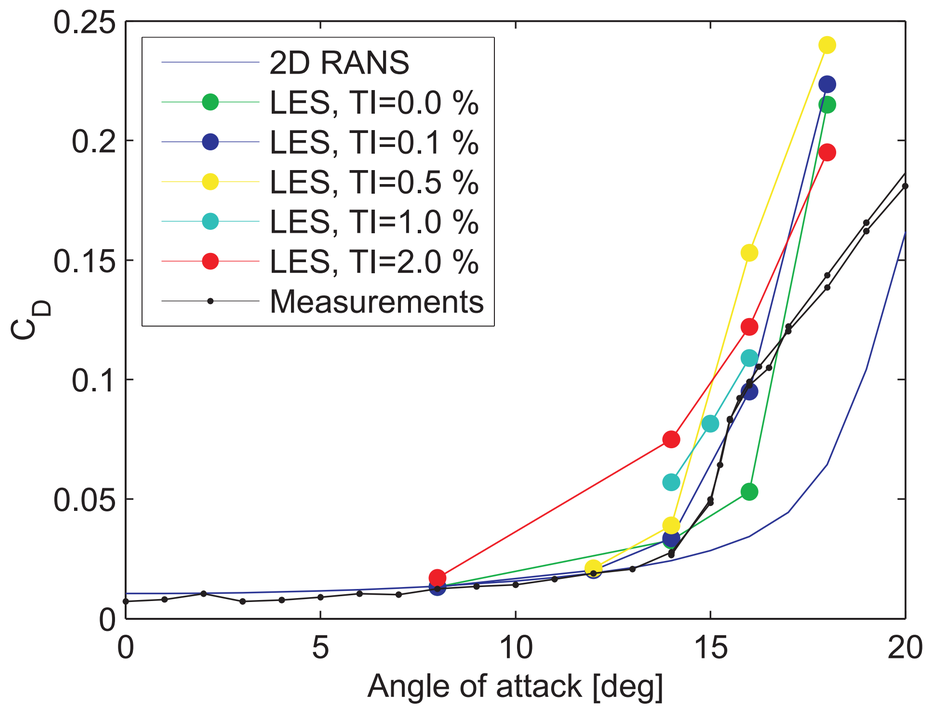
Computational Setup

- The flow past a NACA 0015 airfoil is studied
- Large eddy simulations are performed
- Turbulence intensity and angle of attack is varied
- The Navier-Stokes equations are solved by the EllipSys3D flow solver
- Wall boundary layer is modeled by detached eddy simulation
- The k-ω SST turbulence model is used
- Computational domain resembles outline of wind tunnel



Flow visualization of the inflow turbulence and wake. Iso-vorticity surface colored by streamwise velocity. Background is colored by vorticity. Angle of attack is 16° and the turbulence intensity is 2.0 %.





Lift and Drag

Resolved turbulence

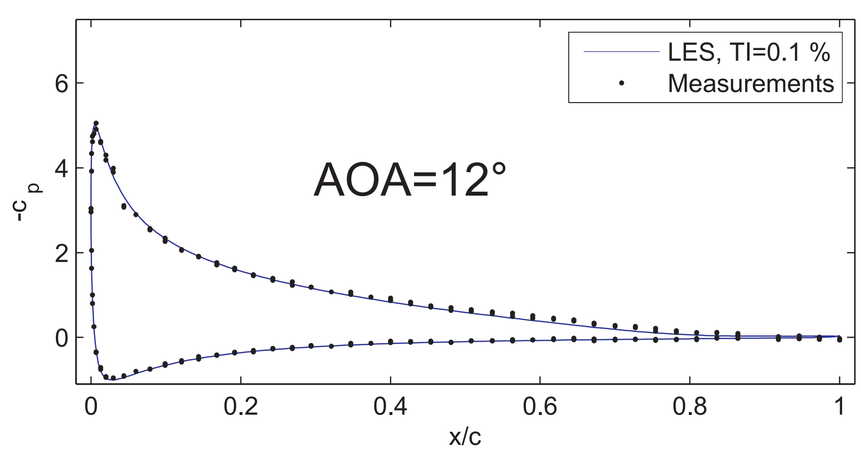
- Has large influence near stall
- Has low influence at low angles of attack
- Decreases lift
- Increases drag

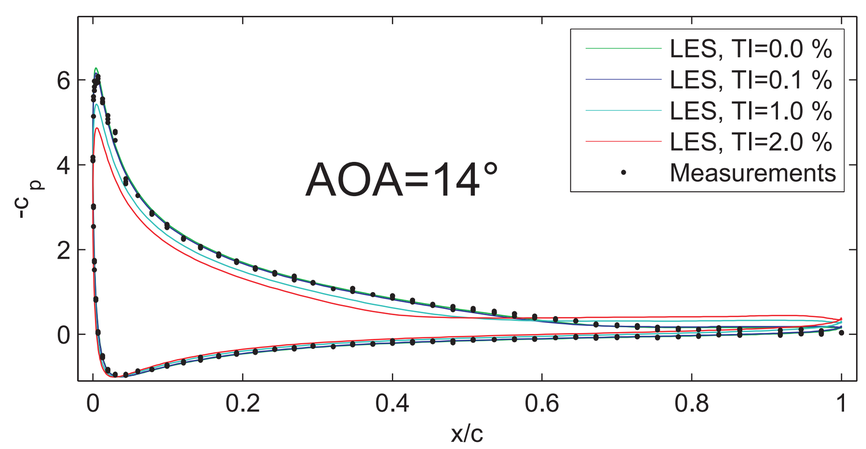
2D RANS

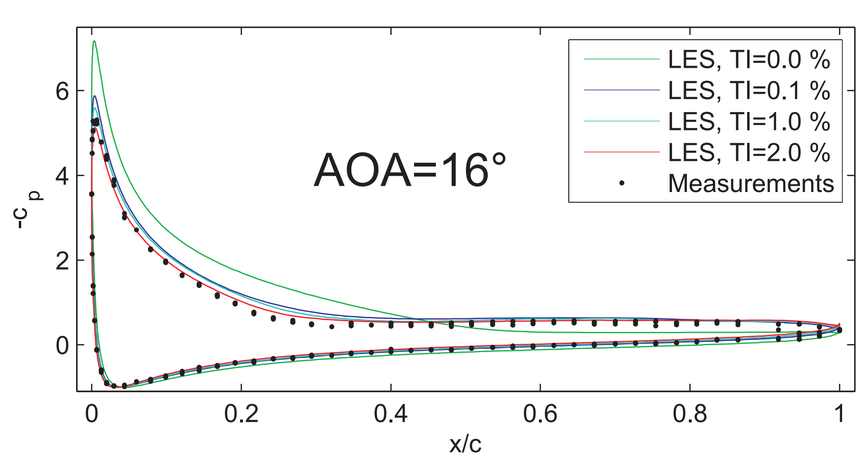
- Good results for small angles of attack
- Fails to predict stall

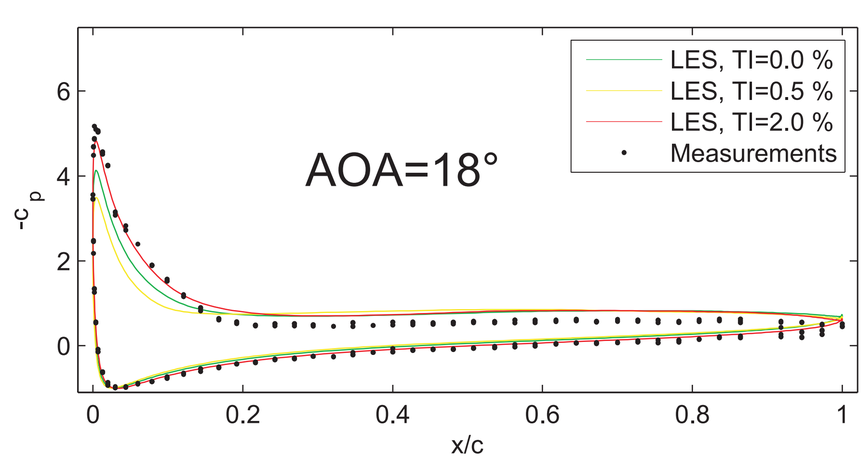
Surface Pressure

- Overall good agreement
- Turbulence moves separation point upstream (not for 18°)
- In the computations the inflow turbulence intensity must be varied with angle of attack to obtain optimal agreement
- The flow at 16° is very sensitive to variation in inflow turbulence









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